**NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DATE: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ PER. \_\_\_\_.**

**HOW CLEAN IS THE WATER?**

**BACKGROUND:**

The water around us is important to our existence. Most people understand the need for clean, safe drinking water. Many of us, however, don't think much about the many different functions of water. Rivers, lakes, and streams serve as a habitat for a variety of living things. We depend more than we realize on the balance of these aquatic organisms. Water is also important for irrigating farmland in many parts of the world. Beside its effects on living things, water is constantly interacting with the physical environment of air, soil, and rocks.

In nature, absolutely pure water is never found. Rain water, which is potentially the purest water in nature, picks up dust and gases from the air. Water in streams and lakes picks up soil materials and the wastes of living things.

Humans have contributed a great deal to the pollution found in water. Cities, factories, and agricultural operations have dumped millions of tons of waste into our water supplies.

While many people know that a problem exists, few really understand what pollution means: Where it comes from; and what can be done about it.

This activity will help you understand water pollution. You will perform tests to measure levels of different pollutants. Throughout the investigations, keep in mind the basic concept of water as a complex mixture of materials with different functions. Try to relate what you learn here to problems of water quality in your area. The most important material used for these experiments is your local water.

**INTRODUCTION:**

Besides water molecules, most water sources contain a variety of other materials. For this we will separate the pollutants into 3 types:

a. Dissolved and undissolved chemicals, such as salt, calcium, phosphates, lead or oil

b. Particulate matter, such as clay, silt, or sand particles

c. Living materials, such as algae, fungi, and bacteria

Most "clean" water supplies contain a mixture of all these materials.

***Water pollution occurs when a new, harmful material is added to the water, or when the balance of naturally occurring materials is upset.***

The first case represents such pollutants as lead and mercury, which are harmful even in very small quantities.

The second case includes such things as the buildup of phosphates in the water supply. Phosphates are found in small amounts naturally, and are necessary for the life of many aquatic organisms. However, in the case of an increased amount of phosphates buildup, the balance is upset with often disastrous effects.

As you work through the activities, decide which of the three types of pollutants you are dealing with, and what the origin of that pollutant might be.

**pH -** Many chemicals which dissolve in water affect how much acid is in the water. Pure distilled water contains no dissolved material. It neutral, with a pH of 7.0 - neither a base nor an acidic. Scientists measure the acidity of water in terms of pH. It is a measurement scale used to describe the acidity (how much acid) or basicity of the water (how much base). The pH scale goes from 0 – 14. Acids have a pH of 0-6.9 and Bases have a pH. of 7.1 – 14. 7.0 is neutral.

**PHOSPHATES -** The element phosphorous is necessary for all life. In water, the most common forms of phosphorous are the phosphates. Phosphates are found in fertilizers, minerals, and in some detergents. Large amounts of phosphates from fertilizer runoff, sewage, etc., will cause algal blooms in the water. This rapid growth of algae uses up the oxygen, so other water plants will not have the sunlight needed for photosynthesis.

**CHLORIDES** - While chlorides are high sea water, fresh water normally contains low levels. The organisms which live in or near fresh water are adapted to these low levels of chloride, and may be harmed by higher amounts. Chloride can build up as water that contains small amounts evaporates, leaving the chlorides behind.

Water which flows through underground caverns may have high amounts of chlorides. Also, salt is used in cold winter areas to melt ice on roads & sidewalks. As much as 1500 pounds of salt per mile of highway may be used during a single heavy storm. This salt flows off the road (runoff) and enters the water and land. In high amounts, salt is very damaging to metals, such as automobiles, or steel hulled ships in salt water – it causes them to rust.

**LEAD** - A number of harmful chemicals, such as mercury, **lead** and cyanide are used in industry. Paper, paint, insecticides and other industries use many of these chemicals to help manufacture their products. When the chemicals have been used up, they are released into water supplies with other waste. These wastes get into the water supplies, often for long periods of time. Mercury and lead are toxic to living things and can cause serious damage life in the water. A variety of chemical tests have been developed to deal with the problem of monitoring such hazardous chemicals.

Lead often enters the water supplies through old lead water pipes. The lead dissolves out of the pipes into the water. Many paints were once made with lead-based pigments. These too can dissolve slowly and enter the water supply.

**OIL** - Many people are concerned about recent oil spills in water. These may be caused by leaks from wells or pipes, damage to tankers, or runoff from streets and factories. Some of the oil floats to the surface of the water and forms a thin film. If you've ever seen a shiny, rainbow colored coating on the water, this was probably oil or some oil-based material. In addition to the harmful effects of any poisons dissolved in the oil, oil coatings cut down the amount of oxygen that can dissolve in the water. This can have serious effects on the organisms that live in the water, since they need oxygen to survive.

**MATERIALS**

3 water samples

25 ml graduated cylinder

1 pipet

2 test tubes

Forceps (tweezers)

Test tube rack

Test tube brush

Soap

Chloride Test Powder (6 pillows)

Chloride Testing Solution

Phosphate Test Powder (4 pillows)

Phosphate Color Chart

Lead Test Paper (1 strip- cut into 3 pieces)

pH Test Paper (3 strips)

Oil Test Paper (1 strip- cut into 3 pieces)

**PROCEDURE:**

1. ***Carefully read the background information section, and all test procedures***

2. You will be performing tests for pH, phosphates, chlorides, lead and oil. Be sure to wash test tubes, pipets and graduated cylinder after each test and when changing water samples.

3. Fill your graduated cylinder with 25 ml of sample water (you will do this 3 times for the 3 samples of water).

4. Test each sample of water for the following pollutants/substances – you will perform each test 3 times.:

**TESTING FOR PH**

a. Dip a strip of the pH paper into the water to be tested.

b. Match the color on one side of the strip with the numbers on the other side of box.

c. Record your answers in Table 1.

**TESTING FOR PHOSPHATES:**

a. Pipet 5 ml of water sample into a clean test tube.

b. Cut off end of the phosphate test powder pillow and add to the test tube.

c. Stopper the test tube and shake 1 minute. A blue or violet color indicates the presence of phosphates.

d. Hold the test tube and color chart side by side against a piece of white paper.

e. Match the colors to determine the phosphate concentration in the sample.

f. Record your answer in Table 1. A reading over 10 ppm indicates a severe pollution problem.

**TESTING FOR CHLORIDES**

a. Pipet *5* ml of the water sample into a test tube.

b. Tap one of the chloride testing powder pillows so that the powder settles to one end. Cut open the end of the powder pillow and add its contents to the water.

c. Gently swirl the test tube to dissolve the contents.

d. Add the chloride testing solution, one drop at a time, swirling gently between each drop. Count the number of drops required to change the color from yellow to orange.

e. To determine how much chloride is in the sample in parts per million (ppm), multiply the number of drops by 50. Record this number in Table 1. – **DO NOT GO OVER 100 DROPS**.

**TESTING FOR LEAD**

a. Cut your lead testing paper into 3 pieces

b. Pipet 2-3 drops of water on to a piece of the lead testing paper.

c. A pink to deep purple-red color indicates the presence of lead at a minimum of 5 ppm. Record this in Table 1.

**TESTING FOR OIL**

a. Using forceps (tweezers), dip a piece of oil test paper into the water sample.

b. A dark blue or purple color indicates the presence of oil.

***REPEAT EACH TEST FOR THE REMINAIN WATER SAMPLES, RECORDING YOUR DATE IN TABLE 1****.*

**RESULTS:**

|  |  |  |  |
| --- | --- | --- | --- |
| **SUBSTANCE** | **SAMPLE A** | **SAMPLE B** | **SAMPLE C** |
| **pH** |  |  |  |
| **Phosphates** |  |  |  |
| **Chlorides** |  |  |  |
| **LEAD** |  |  |  |
| **OIL** |  |  |  |

**TABLE 1:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**CONCLUSION:**

1. What effect do you think large runoffs of soaps and detergents would have on the pH of rivers and lakes?

2. What can you conclude about the effects of the fertilizer, particularly phosphate levels, on algae growth?

3. Why does the ocean have a higher amount of chlorides than a freshwater?

4. A pink to deep purple-red color indicates the presence of lead at a minimum of 5 ppm. Did your samples have more or less than the minimum of 5 ppm. What was the reading for each sample?

5. Which of your samples contained the most oil. Where would you find samples of water with high amounts of oil?

6. Based on the data you collected and the background information, which sample(s) are from salt water and which sample(s) are from freshwater. Explain why you chose these sample(s).

7. Discuss at least 2 ways that water pollution can be regulated and/or controlled.